

2 The First World War (1917 – 1918)

Army Aviation Construction for The Great War

The years of America's brief involvement in the First World War constituted an extremely important phase in the development of U.S. air power. Although the Army's air arm played a decidedly minor role in determining the outcome of the war, the immense effort made by the nation to close the air power gap between itself and the European combatants served as the basis for later developments that would see U.S. Army aviation through the lean years following the war. The wartime operations of the Army's air arm provided considerable practical experience that would help guide its leadership in later years. The exploits of American airmen gave the nation glamorous heroes who placed military aviation firmly in the public eye. Moreover, the rapid mobilization effort included a massive increase in the scope of physical support of U.S. Army aviation, including the development of a great number of new flying fields that would be home to the nation's growing air power.

MAJOR THEMES AND CONTEXTS

WWI Mobilization Flying Training Fields

WWI Mobilization Aviation Support Facilities

Mobilization and Reorganization

As discussed in Chapter 1, the U.S. Army Signal Corps Aviation Section was far from being ready for combat in the skies over Europe when America entered hostilities in April 1917. The 1st Aero Squadron was the only experienced air unit when the United States declared war, and it was still equipped with the same type of obsolete aircraft that had failed so miserably in Mexico. Despite this deplorable state of affairs, the United States pledged to supply the huge flying corps requested by its French allies, who called for a force of 4,500 aircraft, 5,000 pilots, and 50,000 mechanics to be in operation in France by June 1918. Aviation Section personnel calculated that this commitment would require a total force of some 22,000 aircraft — 12,000 of which would have to be the latest combat models — and a training program that could graduate 6,250 pilots in a year. This effort was more than the French themselves had mustered in more than three years of warfare, but a combination of popular naivete and confidence — and perhaps some astute appropriations-hunting on the part of Air Section officers —

convinced most among the American public and within the government that this could be done.

The planned effort was successful at inspiring a vast increase in funding levels, as Congress passed the Aviation Act of 1917 at the end of July. This Act appropriated \$640 million for the expansion of American air power, and allowed the President to expand the Army's air arm as he saw fit. As the United States would learn, however, money could not make up for the simple lack of time. Despite the country's willingness and energy, a basic lack of organization, experience, and established industry doomed the proposed expansion. The Aircraft Production Board was formed in October 1917 to oversee the production of aircraft and related equipment, but ineffective organization and poor communication with an overwhelmed Signal Corps leadership and its still-forming front-line units hampered the Board's activities. By May 1918, it was clear that the promised air armada would not be forthcoming, and a major reorganization was effected. Army aviation was removed from the control of the Signal Corps to form the U.S. Army Air Service, and the new Bureau of Aircraft Production was tasked with the coordination of Air Service needs with Aircraft Board efforts. Production accelerated rapidly thereafter, but only six months remained before the 11 November 1918 armistice. By war's end, more than 10,000 aircraft had been produced by American aircraft factories, but three of every four were trainers — most notably the ubiquitous Curtiss JN-4 "Jenny" — and most of the service types never reached Europe and the front. Of the 3,000 aircraft assigned to the American Zone of Advance throughout the war, less than 700 were American-made and 500 of these were British-designed DH-4 observation aircraft powered by the American-designed Liberty engine.¹

The Army Air Service Goes to War

Mobilization difficulties painfully slaved the commitment of American air power to the allied cause. Not one Army aviation squadron was committed before 1 April 1918. By May, the number still stood at only six combat squadrons, a fraction of the 260 originally promised by June 1918. The Air Service reorganization of late May 1918 brought improvements that helped to overcome earlier problems of inexperienced and poorly organized command structures, poor communications and cooperation between air and ground forces, and irregular material support from the allies. Even with improvements, only 45 squadrons were committed before the 11 November armistice.² Faced with such difficulties in mobilizing, it is little wonder that American air power had relatively little impact on the outcome of the war. Perhaps more surprising were the successes that the Air Service did achieve during its brief tour of duty in France.

The first squadrons to reach the front in April 1918 were assigned to quiet patrol areas where they were exposed to their first combat missions flying Nieuport, SPAD, and Sopwith pursuit aircraft borrowed from the Allies. More exposure came during the Chateau-Thierry campaign of June 1918, in which the first large formations of American units fought together. The defense of the Sainte-Mihiel salient in September 1918 showed some promise for future air power operations, as large formations of allied aircraft under American organization gained local air superiority over the battlefield and conducted bombing attacks on front-line and rear-echelon German units. Experience in interception operations was also gained during the final Meuse-Argonne offensive in the closing months of the war. Throughout their short deployment, Army air units conducted patrol, observation, artillery spotting, and bombardment missions, claiming 781 enemy aircraft and losing 289 of their own. This record is fairly respectable for a fledgling air service in its first test against experienced foes, but far from the demonstrable air superiority that would follow in the next World War.³

Nevertheless, these early accomplishments were crucial to the future development of American air power. The experience gained in mobilization, command, and combat was of key importance, but so was the emergence of a series of popular heroes who caught the imagination of the American public, and helped ensure popular support for aviation in later years. Such history-making and morale-boosting actions as the first air-to-air victories by U.S. aviators — those by Lieutenants Douglas Campbell and Alan Winslow on 14 April 1918 — were the first chapters in what would become a proud tradition of U.S. air power. The Lafayette Escadrille, an American volunteer unit that had fought valiantly with the French Air Forces since 1916, played a very important role in publicizing American aviation exploits. Incorporation of the Lafayette Escadrille into America's air arm in early 1918 brought a much-needed cadre of experienced pilots, as well as a fine boost to morale.⁴ Brigadier General Billy Mitchell also came into the public eye for the first time during the last year of the war, as he acquired experience and formed the theories of air power that he would promote in the postwar years. During WWI, the U.S. cultivated its young Air Service from practically nothing — 311 officers and men before the war started — to an independent service arm of the Army with more than 195,000 officers and men by war's end. It was a promising beginning to what would become the dominant air force of the world.⁵

The Aviation Building Campaign

Early Expansion Activity

Beyond the valuable experience gained in the war, Army aviation also established a substantial physical base from which it could expand during and after the war. The immense increase in the demand for aircraft, pilots, mechanics, and other related personnel called for an airfield building campaign of unprecedented scale. This need was recognized very early on, and steps began to be taken as early as April 1917 to accommodate the anticipated expansion. Before the July 1917 passage of the Aviation Act, more than \$50 million had already been appropriated for Army aviation through emergency acts, with \$13.5 million earmarked for construction of aviation facilities. Acts by Congress in July allowed the Army to procure land for aviation facilities without further legislative approval, and authorized the Army to take possession of North Island without further delay. As a temporary solution in the absence of the required training facilities, the Signal Corps established ground schools at a number of colleges and universities around the country. At these locations, pilot training could begin as soon as instructors arrived, taking advantage of existing facilities and saving time and money. Ground schools were established at:

- Massachusetts Institute of Technology (MIT)
- Cornell University
- University of California
- University of Illinois
- Ohio State University
- University of Texas
- Georgia School of Technology (later the Georgia Institute of Technology)
- Princeton University.

These ground schools operated throughout the war, serving as primary flight training centers and prime recruiting grounds for qualified, college graduate pilot candidates.⁶

Reorganization of the Constructing Agencies

It was clear from the outset, however, that using existing private resources could only be a temporary measure. The Army needed to construct for itself those facilities that were vital to the continued expansion of American air power. To achieve this end, the Signal Corps tasked Lieutenant Colonel Clinton G. Edgar with the reorganization of its Construction Division in May 1917. The Construction Division acquired responsibility for the preparation of plans and the con-

struction, maintenance, and repair of flying fields for the Aviation Section. This action was the first in a series of reorganization efforts that affected the controlling bodies of the aviation construction effort throughout the conflict. Also in May, the Army formed the new Cantonment Division within the Quartermaster Corps, charged with oversight of the emergency construction of 32 new Army cantonments needed for the general mobilization and expansion of the National Army.⁷

This immense building project was largely completed by October 1917 — nearly on schedule — and by this time it had become apparent that greater efficiency could be achieved with the concentration of all mobilization construction under one organization. The Signal Corps Construction Division had already begun construction at 12 new training fields, and other agencies such as the Corps of Engineers and the Ordnance Department had also made sizable construction efforts. All of these programs had begun to compete with each other for both materials and labor. To eliminate competition and increase efficiency, the Army decided to centralize all military construction efforts (with the exception of fortifications, which remained under the Corps of Engineers) under the oversight of the Cantonment Division on 9 October 1917. The competing agencies protested that their own construction efforts were more efficient than those conducted by the Cantonment Division, and a bureaucratic melee ensued that lasted the rest of the war. The Signal Corps, in particular, insisted that its Construction Division was already quite experienced and efficient, and that no savings in time or money could be had by transferring their duties to the Cantonment Division. Furthermore, the Construction Division was utilizing the labor of a number of Aero Construction Squadrons in its program, and its leadership argued that their participation in the Signal Corps building program was valuable training for their anticipated support mission overseas. Despite these arguments, responsibility for airfield construction, as well as planning and design, was centralized into the Cantonment Division with the majority of the Army's other construction needs.⁸

As activities increased in pace and scope, it became necessary to further streamline the construction process. On 9 February 1918, the Cantonment Division was removed from the oversight of the Quartermaster Corps and placed under the direct supervision of the Army Chief of Staff, thus relieving the Office of the Quartermaster General of a significant distraction from its other duties. In March, the Cantonment Division was renamed the U.S. Army Construction Division to signify its broader authority, and this organization assumed responsibility for site selection for all new mobilization projects. In April, the Construction Division was tasked with the production of all standard plans for U.S. Army con-

struction projects, including those for aircraft hangars. This arrangement held good for the remainder of the war.⁹

The Construction Process

The actual process of construction varied less than may be implied by the amount of bureaucratic reorganization above it. For the most part, it appears as though the construction process remained essentially unchanged, with the same people doing the same things under a series of changing administrative structures. The use of standard plans played an important role in maintaining this uniformity across the building program. In May 1917, the Signal Corps' Construction Division commissioned Albert Kahn, the designer of the Langley Field plans, to produce a standard airfield design. He finished this design in only ten days, generating a standard plan on a one-mile-square section that included 12 aircraft hangars and 54 other buildings meant to accommodate 100 aircraft and 150 student pilots. Kahn supplied a standard plan for the 12 hangars, referred to as the Signal Corps Mobilization Hangar. This plan called for a 66 x 120 ft structure of wood framing, wood siding, and asphalt shingle roofing. Bolted wood roof trusses formed a distinctive gambrel profile, and nine wood buttresses augmented each side of the structure. Sliding wood doors on each end featured characteristic exposed wood-frame runners (Figure 2-1). The buildings were situated in a rectilinear arrangement along one side of the section, with the hangars in a row on the flight line and the remaining buildings in parallel rows behind them, leaving the rest of the section devoted to the landing field itself (Figure 2-2). This standard site plan, with all 12 Signal Corps Mobilization Hangars, was implemented at many of the new flying fields established throughout the war, including:¹⁰

- Kelly Fields 1 and 2 (Kelly AFB)
- Chanute Field, Rantoul, IL
- Scott Field, Belleville, IL (Scott AFB)
- March Field, Riverside, CA (March AFB)
- Mather Field, Sacramento, CA.

Although Kahn's standard plan directed the construction of most new airfields, a fair amount of leeway was granted the local constructing officials and contractors in their implementation. They were expected to conform to the plan unless they attained approval to the contrary, but the designs themselves were intended to be adaptable. Local topography and related conditions, coupled with differences in contractor, materials, and construction method preferences, could produce variations from site to site.¹¹ Wright, Bolling, and Pope Fields all show

some deviation from Kahn's standard design that may have been adaptation to local geography (Figure 2-3). Brooks Field received a new Albert Kahn design for its founding in late 1917, calling for a curvilinear arrangement of 65 buildings, of which 16 were hangars (Figure 2-4). Twelve of these hangars were Signal Corps Mobilization Hangars — of which one remains, the only surviving example of this type (Figure 2-5). The other four hangars were to be constructed in accordance with the Air Service's other primary standard hangar design.¹²

This second standard hangar design was the U.S. All-Steel Hangar, produced by the Construction Division. This design appears to have been utilized all over the country throughout the war — and even into the post-war years — without regard to bureaucratic organization. The striking feature of this hangar was a prefabricated, 66-ft steel truss of gambrel profile, any number of which could be erected to form a series of 20-ft modular bays of 14-ft height. The most common versions featured six or seven bays, and thus measured 66 x 120 or 140 ft. Many other versions were erected, however, ranging from 40 to 760 ft in depth. Cladding varied, including corrugated metal, wood, and even brick masonry. The door scheme also varied, sometimes leaving one open end to be closed off with a canvas tarp, and sometimes featuring permanent doors on side or front elevations or both (Figure 2-6). It is difficult to say how many of the U.S. All-Steel Hangars were constructed during the war and how many were constructed in the months shortly afterward. It is certain that by the early 1920s literally hundreds had been erected at Air Service facilities alone, and many more at other Army and Navy installations. The oldest identifiable example can be found at Fort Sam Houston, having been erected there in late 1917, but others at Langley, Rockwell (North Island), Bolling, and Brooks Fields were also certainly constructed during the war (Figure 2-7).¹³

Most construction was executed by contractors, with a relatively small amount of work accomplished by the Aero Construction Squadrons in late 1917. The preferred form of contract changed over the course of the war, but a cost-plus-fixed-fee type dominated overall. This contractual practice tended to be more expensive, but much faster. Early on, the contractors themselves were responsible for the procurement of supplies and materials at the local level, but the government soon took over the central control of materials distribution when vital commodities began to be in short supply. Time was of the essence in the emergency construction programs, and cost-efficiency and fiscal responsibility were often sacrificed for the sake of speedy completion. Most contracts throughout the war were completed within the standard 60-day deadline, despite complications arising from labor, transport, and supply problems. The quality of the resulting construction, however, was not generally high. Most fields received only temporary construction, with wood-framed buildings and wood- or steel-framed hangars,

and most landing surfaces were of grass, dirt, or cinder. Only two fields — Langley and Rockwell, both begun before America's entry into the war — received any permanent construction, and even that was greatly reduced from the amount called for in the original plans. Only McCook Field in Dayton, OH, featured a hard-surfaced runway. Many fields were still under construction when the war ended, and some of these were simply abandoned and their construction contracts canceled.¹⁴

The expansion of the Army's air operations required a broad range of facilities types. A great number of flying training fields were necessary for primary and advanced pilot training, as well as the training of air crewmen in bombing and gunnery schools, and these fields made up the bulk of the facilities constructed during the war. But the Aviation Section also required other aviation support facilities, such as "concentration camps," in which recruits were brought together for basic training prior to their assignment to other units. Also needed were aviation general supply depots — regional centers for the storage and distribution of aircraft engines, supplies, and spares — and aviation general repair depots which housed maintenance, rework, overhaul, and modification operations for their respective regions. These facilities were commonly located near flying fields or were in a position central to a number of fields. The Aviation Section also required acceptance parks, where aircraft received from factories could be given their shakedown test flights. Four such parks were established, all near centers of aircraft production. Other special training facilities were constructed in conjunction with cooperative Army activities, such as the artillery observers' school at Fort Sill. Finally, two separate transshipment depots were established on the east coast at Middletown, PA, and Richmond, VA, to support the transport of men and materiel to Europe.¹⁵

The Five Waves of Construction

These new aviation facilities were constructed in five general "waves" of building activity spread throughout the war. Each wave consisted of a number of facilities chosen for development at about the same time, and by the same administrative body. The first wave included those facilities that were already begun by the time the United States entered the war along with those sites chosen for development in the first two months of the war, May and June 1917. Five facilities were scheduled to continue the construction programs that had begun in early 1917:

- Rockwell Field, CA (North Island)
- Langley Field (Langley AFB)

- Kelly Field (Kelly AFB)
- Chandler Field, AZ (Williams AFB)
- Hazelhurst Field.

Both Langley and Rockwell Fields largely abandoned attempts to continue permanent construction, opting for greater numbers of temporary hangars that were cheaper and easier to construct. Langley, for example, erected a staggering number of temporary hangars, including at least 10 of the standard U.S. All Steel Hangars of 140-ft depth, as well as an even greater number of simpler corrugated metal hangars and other Theater of Operations-type wood-and-canvas structures (Figure 2-8).¹⁶

Five new sites were selected for the construction of flying fields by Brigadier General Benjamin Foulois, head of the Aviation Section, and Lieutenant Colonel Edgar:

- Selfridge Field, at Mount Clements, MI (Selfridge ANGB*) — previously served the Packard Motor Company as an aircraft engine test field.
- Chanute Field
- Scott Field (Scott AFB)
- Wilbur Wright Field, Dayton, OH (Wright-Patterson AFB)
- Kelly Field 2 (Kelly AFB).

The Aircraft Production Board also recommended during this period that an aircraft test facility be developed at Dayton, OH, to supplement the facility under construction at Langley Field. Some question remains as to the propriety of this decision, but a lease was signed and the Airplane Engineering Department would eventually move its headquarters to McCook Field in December 1917. By the middle of the summer of 1917, construction was already under way at the five new sites, under the control of the Signal Corps Construction Division.¹⁷

Edgar organized the Signal Corps' first Site Selection Board in June 1917. This Board identified the sites that would constitute the second wave of airfield construction. The Site Selection Boards had little in the way of guidance regulations: they were simply small groups that toured sites prepared for inspection by local interests. Nevertheless, this system remained remarkably free of any hint of graft or corruption. Sites approved by the Site Selection Board, were for-

* ANGB: Air National Guard Base.

warded to the Signal Corps Headquarters for endorsement, then advanced to the Adjutant General's Office. There legal agreements were prepared, arranging for local contractors to erect the necessary buildings in accordance with standard plans provided by the Construction Division. The first Board chose seven sites:

- Park Field, at Memphis, TN (NAS Memphis)
- Gerstner Field, at Lake Charles, LA
- Carruthers Field, at Dallas, TX
- Barron Field, at Fort Worth, TX
- Rich Field, at Waco, TX
- Call Field, at Wichita Falls, TX
- Ellington Field, at Houston, TX (Ellington Field ANGB).

The first Board also reopened the Balloon School at Fort Omaha, NE, and expanded the field at Fort Sill to facilitate artillery observer training.¹⁸

A new Site Selection Board selected the third wave of new airfields in the fall of 1917. Following an Aircraft Board resolution, the new sites were all in the South and Pacific Coast regions, in an attempt to avoid the winter weather of the northern half of the country. The selected sites were:

- Brooks Field, at San Antonio, TX (Brooks AFB)
- Eberts Field, at Lonoke, AK
- Taylor Field, at Montgomery, AL
- Heistand Field, at Arcadia, FL
- Valentine Field, at Arcadia, FL
- Indianapolis, IN (motor speedway selected for Aviation Depot site).

The site for another new flying field was also acquired during this period — though not by the Site Selection Board — on the Anacostia Flats near Washington, DC (Bolling Field, now Bolling AFB). This land was transferred from the Department of the Interior in November 1917, and was utilized for both aircraft testing and air defense of the nation's capital. The construction efforts at these third-wave sites were the first taken over by the Cantonment Division following the October 1917 reorganization.¹⁹

The fourth wave of airfield construction began in early 1918, as the third and last Signal Corps Site Selection Board began to select new locations. Flying fields were located at:

- Souther Field, at Americus, GA (later joined by an Aviation General Supply Depot at an adjacent site)

- Payne Field, at West Point, MS
- March Field (March AFB)
- Mather Field.

The site for another Aviation General Supply Depot was chosen at Morrison, VA. Subsequent to this last wave of site selections conducted by the Signal Corps itself, this responsibility was transferred to the newly created U.S. Army Construction Division.²⁰

The fifth and final wave consisted of those facilities sited and constructed under the authority of the Construction Division over the closing months of the war. Many of these sites were support facilities, especially depots, and some were not yet completed by the close of hostilities in November 1918. Five Aviation General Supply Depots, two Transshipment Depots, four Aviation Acceptance Parks, and a small number of flying fields may be identified in this last wave, including:

- Montgomery, AL — Aviation General Supply Depot (Maxwell AFB)
- Fairfield, OH — Aviation General Supply Depot (Wright-Patterson AFB)
- Little Rock, AK — Aviation General Supply Depot
- Dallas, TX — Aviation General Supply Depot
- San Antonio, TX — Aviation General Supply Depot
- Richmond, VA — Transshipment Depot
- Middletown, PA — Transshipment Depot
- Dayton, OH — Aviation Acceptance Park
- Buffalo, NY — Aviation Acceptance Park
- Detroit, MI — Aviation Acceptance Park
- Elizabeth, NJ — Aviation Acceptance Park
- Pope Field, at Fayetteville, NC (Pope AFB)
- Chapman Field, at Miami, FL
- Love Field, at Dallas, TX.

In addition, a great deal of work was done, outside the immediate supervision of the Construction Division, on a complex of flying fields centered around Hazelhurst Field on Long Island, NY. These facilities included Damm, Brindley, Lufberry, Miller, Roosevelt, and Mitchel Fields, the last of which developed into the most important and long-lasting of the bunch.²¹

The vast majority of the construction completed in the five wave was of a temporary nature. Many of the fields were abandoned following the armistice in November 1918, and some ongoing construction projects were halted in mid-run. On the other hand, 15 of these mobilization fields continue to serve as perma-

ment bases even today, a reminder of the critical two years when American air power made its first great strides and established a network of ground facilities that would support its development over the following decades of peace.

Navy and Marine Corps Aviation Construction for the War

Echoing the Army's experience in World War I, the Navy's involvement in the Great War laid the foundation for the advancement of American naval air power. As in the Army's case, few would contend that the Navy's air arm played a critical role in bringing about the Allied victory, but the war effort had a profound energizing effect that would serve as a catapult toward later developments. Lessons learned during the conflict would guide Navy leadership in the postwar period, and the exploits of America's naval aviators kept the maturing program firmly in the eye of the Navy brass and the American public. In addition, the impressive mobilization effort sparked a building campaign that would provide the Navy with aviation facilities needed to support postwar development.

MAJOR THEMES AND CONTEXTS

WWI Continental Naval Air Patrol

WWI Naval Air Training

Tooling Up to Fight

The U.S. entry into the war in April 1917 found the Navy's air arm completely unprepared for active combat service in Europe. Its total strength stood at just 43 officers, 230 enlisted men, and 54 aircraft operating out of its single air station at Pensacola, FL. Urgent requests were received from America's British and French allies immediately, calling for great numbers of men, ships, and planes to combat the rising German U-boat menace. This would become the Navy's primary mission for the duration of the war. It was clear, however, that much work had to be done before naval aviation could play its appointed role in the conflict. To fulfill that role, manpower, funding, aircraft, and aviation facilities would have to grow to an unprecedented scale. A rapid reorganization effort commenced in order to support the needed expansion.²²

The first steps in reorganization were the naming of Captain Noble E. Irwin as Director of Naval Aviation, and the creation of Aviation Sections within the various Bureaus of the Navy to expedite administrative matters. One such section was created in the Bureau of Yards and Docks under the leadership of Civil Engineer (later Rear Admiral) Kirby Smith, who coordinated the construction campaign that would provide the needed aviation facilities. The major recruitment effort needed to expand the ranks of naval aviators was coordinated by Lieuten-

ant John H. Towers, who was put in charge of the Naval Reserve Flying Corps. This organization provided the vast majority of the Navy's pilot candidates. Funding for the coming expansion was provided by a series of additional appropriations throughout 1917. Three million dollars were appropriated for naval aviation in April, followed by \$11 million in June and \$45 million in October. The great quantities of new aircraft needed were to be procured in conjunction with the Army through the Aircraft Production Board. Through this board both services acquired large numbers of Curtiss JN-4 "Jenny" trainers — fitted with floats and designated the N-9 by the Navy — and British-designed DeHaviland DH-4s powered by Liberty engines. The Navy also received a series of flying boats for patrol work, including the HS-1, H-16, R-6, and finally the F-5L.²³

Naval Aviation at War

Given that the German High Seas Fleet had been bottled up in the Baltic Sea since the Battle of Jutland in 1916, the principal threat to Allied naval operations remained the German submarine fleet. The primary mission of the Navy's air arm was therefore reconnaissance and observation, for which the seaplane was the aircraft of choice. American aviation units operated in this scouting capacity out of seaplane bases in the United States, France, Great Britain, and Italy. Anti-Submarine Warfare (ASW) patrols began immediately in April 1917, operating out of emergency coastal patrol stations along the eastern seaboard, such as the one set up at Mastic, Long Island. By the summer of 1917, these operations had escalated and were based out of a series of temporary coastal patrol stations constructed by the Bureau of Yards and Docks.²⁴

The same ASW patrol duties awaited naval aviators in Europe. The first American military unit to reach Europe was actually a detachment of naval aviators who arrived in France without aircraft in June 1917. This unit, under the leadership of Lieutenant Kenneth Whiting, was really intended more as a visible sign of American support than anything else. Whiting, however, decided that as long as they were in France, they might just as well be fighting, and personally committed his men to begin combat flight training in French aircraft at the French Army School at Tours. He then agreed to staff a French coastal observation field on the English Channel at Dunkirk, and followed quickly with new commitments to three other fields in the area. His plans were approved after the fact by an understanding admiralty, whereupon Whiting submitted a plan to occupy a total of 12 French coastal observation stations. Eventually, a plan for American naval aviation patrol operations out of 15 French fields was approved in August 1917. Further commitments were made to man facilities in Great Britain, in order to hunt for U-boats in the North Sea and the Atlantic sea lanes.

Similar arrangements were also made for operating out of northern Italy in the closing stages of the war.

In the early stages of their activities in Europe, American naval aviators operated under adverse conditions, arising most notably from the difficulties encountered by their allies in fulfilling their commitments to construct the necessary airfields and supply operational aircraft. The French, for example, delivered only about a third of the aircraft the Navy ordered from them, and much of the construction on the new French patrol stations was eventually completed by the Navy's Bureau of Yards and Docks. In addition to their primary reconnaissance duties, Navy fliers also planned to execute a bombing campaign against U-boat pens in Belgium. Delays in reaching operational capability dictated that the bombing campaign would not commence before August 1918, and the first all-American flight would not operate until October. By that time, the Germans had already abandoned these forward submarine bases. The Northern Bombing Group was then shifted to cooperative attacks with the British 5th Group, Royal Air Force (RAF) in support of November ground offensives.²⁵

In the 19 months preceding the 11 November 1918 Armistice, American naval aviation had deployed some 1,100 officers, 18,000 enlisted men, and 570 aircraft abroad. From its 20 patrol bases it had covered more than 790,000 nautical miles, spotted 27 enemy submarines, and damaged about half of them. Nearly 100,000 pounds of bombs were dropped by naval aviators throughout the conflict, with perhaps a quarter of that total delivered during all-American raids conducted by the Northern Bombing Group. By war's end, the Navy's air arm had grown to more than 6,700 officers (of which some 4,000 were qualified pilots) and 30,000 enlisted men, flying more than 2,100 airplanes.²⁶ All things considered, the Navy had made a credible showing in Europe, and conducted an admirable buildup in air power despite some daunting obstacles. This performance was made possible only by vigorous recruiting, training, aircraft production, and air station construction programs at home in the United States. Of all these domestic programs, the construction campaign was surely that which left the most lasting impression, shaping the future development of U.S. Naval Aviation.

The Construction Campaign

Continental Naval Air Patrol Stations

The construction campaign initiated by the Bureau of Yards and Docks in support of naval aviation revolved around two pressing needs that faced the Navy as it entered hostilities in April 1917:

- A system of naval air patrol stations from which it could patrol the Atlantic approaches to the east coast. (These were the predecessors of similar patrol stations in Europe, discussed above.)
- A greatly expanded system of training fields and facilities at which it could mold the exploding number of recruits into naval aviators and air crewmen.

Fortunately for the Navy, it had already taken steps toward satisfying the first requirement, and the construction of eight standardized coastal patrol stations followed soon after the U.S. declaration of war. As early as 5 February 1917, anticipating U.S. involvement in the war, the Chief of Naval Operations had recommended more substantial facilities for eight air patrol stations at strategic positions along the Atlantic coast. The typical naval air station was to feature two steel-framed hangars — one for airships and one for seaplanes. It would also include support structures for shop activities, for truck, boat, and general storage, and for the production of hydrogen and power. Officers' and enlisted men's quarters, a mess hall, and recreation buildings accommodated personnel. Plans were based on an average expenditure of \$300,000 per site.²⁷

The standard airship hangar measured 250 x 133 x 66 ft, and featured steel structural elements and metal cladding. These hangars were designed on the three-hinged arch principle, with 12 arch ribs for each completed hangar. Contracts were let separately for the large two-leaved doors. The steelwork for each complete structure averaged about 370 tons, and the cost was in the neighborhood of \$375,000, not including foundations and cladding (Figure 2-9).²⁸ The standard seaplane hangar — known as the 75-Foot Coastal Air Station Seaplane Hangar — measured 112 x 75 x 24 ft, and also featured steel truss construction in a distinctive gambrel profile. The structure consisted of vertical steel A-frame supports that formed the walls and supported a high gambrel roof truss. The hangar was clad entirely in corrugated metal. This hangar closely parallels the Army's U.S. All-Steel Hangar in three major ways. First, its component parts — especially the distinctive truss — were mass produced. The hangar was classified as temporary construction, and could probably be demounted and re-erected at another site at low cost. Finally, while a number were constructed during the war, even more appear to have been erected shortly after the war from excess components already in the Navy's possession (Figure 2-10).

A contract for the construction of the eight LTA hangars for these bases was actually already in place by April 1917, prior to the establishment of the coastal sites. This contract provided for the fabrication of the eight airship hangars and their erection at sites to be named at a later date. By June 1917, site selection for the eight patrol stations was completed and construction began on a cost-plus basis from a fiscal year 1917 appropriation of \$3.5 million. The construction ef-

fort was completed at some stations by the autumn of 1917, and all were operational by early 1918. The designated sites were:

- Montauk, Long Island, NY
- Rockaway Beach, Long Island, NY
- Cape May, NJ
- Key West, FL (NAS Key West)
- Chatham, MA
- Bay Shore, Long Island, NY
- Hampton Roads, VA (NAS Norfolk)
- Coco Solo, Panama Canal Zone.

Seven of the eight new coastal patrol stations received one of the airship hangars as planned, with Bay Shore as the lone exception. Five of the bases — Montauk, Rockaway, Cape May, Key West, and Chatham — also received a single standard 75-Foot Coastal Air Station Seaplane Hangar, as planned. Bay Shore deviated from the standard station layout in that it received only a single example of the Navy's third standard hangar design. This wood-framed seaplane hangar was designed to shelter three aircraft. It measured 65 x 183 x 24 ft, and consisted of three regular flat-gabled 61 ft bays. No permanent doors were included, only simple canvas curtains. This was the first wood-framed hangar erected by the Navy during the War, part of the Bureau of Yards and Docks' attempt to conserve vital steel reserves wherever possible (Figure 2-11). Coco Solo also appears to have received two similar wood-framed hangars that may have employed the same structural cross-section but were much longer, approaching a 400 ft length on the base layout plan. Most likely, they simply employed six of the 61 ft hangar bays, instead of the standard three. Hampton Roads deviated significantly from the standard plan. It received four wooden hangars measuring 105 x 104 x 24 ft that appear to conform to the Bureau of Yards and Docks' standard 105 x 104 x 24 Foot Timber Seaplane Hangar design.* This plan represents the Navy's fourth major standard hangar design of this period. It utilized wood construction throughout, and featured a very distinctive arched wood-lattice truss (Figure 2-12). A variant of the same plan combined two of these hangars into a single, larger, double-bayed structure referred to (not surprisingly) as the 210 x 104 x 24

* This plan was not approved as standard until May 1918, but it was fairly common practice for the Bureau to adopt earlier hangar plans as standard designs. This appears to be the case here, although the standard plan employed two of these 105 x 104 ft bays to form the larger double hangar.

Foot Timber Seaplane Hangar (Figure 2-13). Both hangars featured characteristic exposed, wood-framed door runners.

This same type of wood-lattice truss construction is also evident in the Navy's fifth standard WWI hangar design. The 220 x 160 x 32 Foot Timber Seaplane Hangar featured two large bays, each measuring 112 x 160 ft, spanned by 112-ft wood-lattice arched trusswork.* It resembles the 210 x 104 x 24 Foot Timber Seaplane Hangar in almost every respect, with the sole difference being the slightly larger dimensions. Both the 210 x 104 x 24 Foot and the 220 x 160 x 32 Foot Timber Seaplane Hangar designs appear to have been employed extensively in the expansion programs that followed the original coastal patrol station program (see below). Hampton Roads, for example, received two triple-bay hangars that conform to the larger plan in all respects, except the presence of the third bay (Figure 2-14). The new station at Anacostia appears to have received two of the smaller hangars and one of the larger. Cape May looks to have received one standard 210 x 104 x 24-footer, and one of the same type with a slightly raised roof. It also appears as though both of these standard plans, as well as the flat-gabled wood design from Bay Shore, were used extensively in overseas construction.

Supplemental Naval Air Patrol and Training Bases

Before construction of the first eight patrol stations had even been completed, it was apparent that additional coastal facilities would be necessary to provide for increased patrols and aviation training.²⁹ To that end, expansion programs at the established coastal patrol stations were initiated, and new supplemental patrol and training stations were begun. These new stations were sited at:

- Akron, OH (LTA)
- Anacostia, DC (Bolling AFB)
- Miami, FL
- Morehead City, NC
- Brunswick, GA.

* The 220 ft measurement of the title was an approximation, because the plan itself details two bays of the 112-ft span, which obviously could not combine for a total span of only 220 ft. It was standard practice for the titles of these early Bureau of Yards and Docks designs to have rounded-off approximates of the actual dimensions.

The station at Akron, exclusively for airships, was appropriately sited near the Goodyear Tire and Rubber Company plant in an area later known as Wingfoot. A 400 x 100 x 100 ft airship hangar was constructed in mid-1917 with accompanying hops, quarters, and mess facilities.³⁰ Until November 1917, the Navy made use of the Army landing field at Anacostia (Bolling Field) for the erection of a seaplane hangar for operation by both services. By January 1918, they had established a Naval Air Station there, consisting initially of a wooden hangar and two small support structures. Subsequent facilities, to include two additional temporary hangars, an administration building, and barracks, followed shortly in early 1918. All three hangars at Anacostia were of temporary construction.³¹ The station at Miami was established in January 1918 and became the Navy's site for a gunnery school, a special radio school, and preliminary training in night flying.³² On 17 September 1918, Morehead City, otherwise known as Cape Lookout, was established at Camp Glenn, a former North Carolina state militia camp. Initially used only as a refueling station, Morehead City became a full-fledged seaplane base on 1 October 1918. Construction at Brunswick, however, did not begin until 21 October 1918.³³ Brunswick's requirements were set at six seaplanes and three kite-balloon hangars, but at the time of the Armistice, the base had yet to receive its first aircraft.³⁴

Naval Air Training Bases

In order to execute the missions envisioned for it by U.S. and Allied leaders, naval aviation needed far more manpower than was available at the start of the war — even more than could be trained in existing facilities. In addition to the operational patrol stations, the Navy needed dedicated training facilities to produce huge numbers of qualified pilots. NAS Pensacola was the site of all aviation training at the outbreak of war, but it could only accept 64 pilot trainees at a time. Many temporary camps were thrown together to augment this capability, and additional courses were set up at colleges and universities for the Navy as they were for the Army, and in industry as well.³⁵ The first of these appeared immediately in April 1917, when an existing militia station at Squantum, MA, was converted for air training.³⁶ Throughout the last half of 1917, preliminary flight training programs were established at the following locations, taking advantage of existing aviation support facilities:

- Hampton Roads (NAS Norfolk)
- Key West (NAS Key West)
- Bay Shore
- Miami
- East Greenwich, RI

- Curtiss Exhibition School, Newport News, VA
- Rockaway (LTA)
- Akron (LTA).

As the training burden continued to grow, more facilities were established across the country to accommodate new classes. Many were located away from the East Coast to ease logistic and traffic loads there. A number of these new schools were established at universities and professional schools. These schools for pilots, ground crewmen, and mechanics included:

- Great Lakes, IL
- Charleston, SC
- Santa Rosa, FL
- University of Washington
- Dunwoody Institute, Minneapolis, MN
- Harvard University
- MIT.

Despite the founding of these new facilities, NAS Pensacola remained the centerpiece of naval air training. This facility conducted both primary and advanced pilot training until May 1917, when primary training was shifted to other locations. Thereafter, it accepted pilot candidates who had completed primary training at one of the newest seven schools listed. Pensacola graduates would then advance to finishing schools in France, where they would briefly train with French or American combat veterans.³⁷ A vigorous construction program supported the frenetic activity at Pensacola, where the training load peaked at more than 5,000 men and 150 aircraft operating in its schools simultaneously. A total of 13 new hangars were constructed during the war to house these trainer aircraft, including eight wooden seaplane hangars and one large steel airship hangar completed in 1917. The latter was constructed by the Virginia Bridge and Iron Works of Roanoke, VA, at what is now known as Chevalier Field. The floating hangar that had seen only brief service in the prewar period was moved to shore and reassembled next to its newer counterpart, minus the pontoons that had kept it afloat. In 1918, NAS Pensacola received three steel and asbestos seaplane hangars, as well as a seaplane erecting shop of the same material. This construction was classified as semi-permanent by the Bureau of Yards and Docks. These four structures appear to have been the only applications of this kind of construction for naval aviation purposes.³⁸

The only other example of non-temporary construction in support of naval aviation was the development of NAS San Diego, now known as NAS North Island. The site for this facility was first established in December 1917, after Congress

had allowed the Army to take possession of North Island to expand its training operation there. The Navy requested the use of the northern half of the island in order to have better access to the calm waters of the Spanish Bight and San Diego Bay, so the Army agreed to relocate to the southern half of the island. A tentative layout was completed by the supervising architect, Bertram Grosvenor Goodhue, before the end of January 1918. Contracts were let for much of the construction, including the first two seaplane hangars, by July 1918. Few of the new facilities were finished before the Armistice, with much of the construction reaching completion only near the end of 1919. Consequently, this new facility's impact on the training system during the war was quite limited. It did, however, signal a new method of development for Naval aviation bases. Unlike NAS Pensacola, NAS North Island was designed from the start in a coherent, unified architectural style featuring Spanish Mission Revival elements, and buildings were sited with formal symmetry. Permanent construction was the norm, although some temporary structures were also built. It also signaled a new trend in the price of airfield construction: it cost as much to design and build as did all eight of the original temporary coastal patrol stations in 1917. As the Navy's need for aviators grew, so did its requirements for construction appropriations, which peaked at more than \$30 million for the war period.³⁹

Expanding the Marine Corps' Independent Mission

The First World War marked a very important phase in the development of the Marine Corps, as it made significant strides in advancing its new independent mission. This period lay the foundation for establishing the Atlantic Coast Advanced Base and Expeditionary Force, with its own home shore facility, and brought growing recognition of the important role played by Marine Corps aviation in the advanced base security mission. Like their army and naval aviator counterparts, marine aviators played a relatively minor role in determining the outcome of World War I. Nevertheless, they similarly took advantage of the massive mobilization effort to lay the foundation for later developments in the Marine Corps' air service.

Mobilization

The Marine Corps entered the war with a total force of about 500 officers and 13,000 enlisted men. By November 1918 it numbered 2,400 officers and 70,000 enlisted men. Captain Cunningham and the Marine Aviation Company did all they could to ensure that they also reaped the benefits of this massive up-scaling. In April 1917, the newly formed Marine Corps Aviation Company could muster only 10 officer pilots, 40 enlisted men, and no aircraft of its own.

Captain Cunningham, the *de facto* director of Marine Corps aviation, must be given much of the credit for organizing its expansion. He was determined that the Corps' own air units would be sent to France to play an active role in combat operations there, specifically to support the Marine Brigade slated to fight in the trenches on the Western Front. The Marine Corps Aviation Company was assigned two missions for its deployment to Europe, including ASW seaplane patrols out of the Azores, and observation and bombardment support for the Marine Expeditionary Force in France. For these purposes, two new aviation units were organized in the summer of 1917: the 1st Aeronautic Company and the 1st Marine Aviation Force, equipped with their own aircraft — mostly HS-2L flying boats, N-9 and R-6 seaplanes, and DH-4 observation planes.⁴⁰ The 1st Aeronautic Company was tasked with the seaplane patrol mission, while the 1st Marine Aviation Force was assigned the landplane missions in France.⁴¹ Together these units grew over the course of the war to a respectable complement of 282 officers and 2,180 enlisted men.

Marine Corps Aviation Joins the Fight

The 1st Aeronautic Company was first to fight. Under the direction of Captain Francis T. Evans, this unit recruited the necessary manpower in the form of volunteers from the new advanced training and officers' schools at Quantico, VA, and from the Marine Corps Reserve Officer Corps. By October, the Aeronautic Company was up to strength at 34 officers and 330 enlisted men, and had begun training in its R-6 seaplanes at NAS Cape May, NJ. Taking station in the Azores in January 1918, the Marine aviators conducted routine ASW patrols throughout the year, flying ten R-6 and two N-9 seaplanes, and six HS-2L flying boats.⁴²

The 1st Aviation Force had a more eventful experience, including an exceedingly convoluted recruiting and training process before it even left the United States. This unit was in dire need of qualified pilots in order to reach its projected strength of four squadrons, so Cunningham began to comb the Corps for likely candidates. Even after his thorough efforts he was far short of the mark and resorted to scouring Naval Air Stations, recruiting young Reserve pilots who wanted to fight in France. In all, 78 of the 135 pilots who deployed to France were transferred naval officers. Furthermore, the training agreement that had been reached with the Signal Corps called for the Marine aviators to receive landplane instruction aboard Signal Corps aircraft at the Signal Corps school at Hazelhurst Field, Long Island, NY. When the New York January turned too cold for the instructors' tastes, they refused to continue training the Marines. Captain William McIlvain took the initiative to commandeer a train and relocate his men and their JN-4 trainers to the Signal Corps advanced training school at Houston, TX. McIlvain received orders *en route* to report to the Signal Corps

Field at Lake Charles, LA, instead of Houston. On arriving there, the local commander refused to accept the Marine contingent, as he had received no notice of their assignment. This situation was resolved after a few days, but in April 1918 McIlvain's force relocated again to the new Marine Corps Flying Field at Miami, FL.⁴³

The Miami facility had been a functioning Curtiss Aircraft Company flying school until February 1918. At that time, Marine Captain Roy Geiger absorbed the entire operation into the Corps, granting commissions to the civilian instructors in order that Marine Corps pilots would no longer have to rely on Army instruction. Training in landplanes and seaplanes continued at Miami until the Aviation Force left for Europe in July 1918. Upon arriving in France, the Marines found that their aircraft had not been delivered as scheduled, and were forced to fly with British units in borrowed aircraft until October. By that time, when they finally joined the Northern Bombing Group as intended, the Germans had already abandoned the U-boat bases that had been the Marines intended targets, so activities were shifted to the support of advancing British units. During their tour in France, the Marines of the 1st Aviation Force participated in 57 missions, sustained seven total casualties, and shot down 12 enemy aircraft.⁴⁴ While neither of the Marine Corps aviation deployments could be said to have played a decisive role in WWI, both were executed with admirable drive and dedication, and served to increase the legitimacy of Marine aviation in its own ranks and in the eyes of the other services.

The Construction Campaign

The Marine Corps' aviation-specific construction campaign during this period was minor. Marine Corps facilities continued to be designed and constructed by the Bureau of Yards and Docks in conjunction with the Navy's own building campaign.

Technically, the first official Marine Corps aviation unit was established at Quantico's new officer training facility in the form of a balloon company attached to the artillery school. Aviation training was conducted at both Parris Island and Quantico, but it was not a major activity at either location. Therefore, neither installation appears to have supported an aviation construction program.

The first designated Marine Corps Air Station was actually the flying school established in February 1918 by Captain Geiger out of the Curtiss School in Miami. Early on, tent hangars were used there to house their JN-4 trainers. Shortly thereafter, a couple of wood-frame hangars were constructed along the airstrip. By the time the 1st Marine Aviation Force departed Miami for Europe,

they left behind a bustling complex of hangars, shops, and warehouses.⁴⁵ Establishment of the Marine Corps Air Station at Miami was a direct acknowledgment that the Marines needed their own shore facilities. While the base at Miami closed immediately after the Armistice, its brief existence served as a precedent for building new air stations at Quantico and Parris Island during the Interwar Years.

Table 2-1. First World War, U.S. Army aviation.

	APR – JUN 1917	JUL – SEP 1917	OCT – DEC 1917	JAN – MAR 1918	APR – JUN 1918	JUL – SEP 1918	OCT – NOV 1918
Military Conflicts	6 April: U.S. declares war on Germany				June: Chateau-Thierry Campaign	September: St-Mihiel Campaign	11 November: Armistice declared
Army Aircraft	April: 1st Aero Squadron still flying JN-3s as only operational squadron				April: New squadrons flying allied pursuit planes Nieuport 17 & 28, SPAD XIII, S.E. 5		10,000 total aircraft produced in U.S.: 3/4 are JN-4 "Jenny" trainers 500 British-designed DH-4s are bulk of U.S.-built combat aircraft
Army Aviation Operations					1 April: First Army squadron reaches Europe 14 April: First-ever U.S. aviation combat kills May: 6 squadrons in theater		November: 45 squadrons committed
Army Aviation Administration	May: Pledge to supply 4,500 aircraft by June 1918	July: Aviation Act appropriates \$640 million for expansion of airpower			May: Formation of U.S. Army Air Service		
Construction Support for Army Aviation	May: Temporary ground schools at many universities Organization of Signal Corps Construction Div. Standard airfield layout produced by A. Kahn; included design for Signal Corps Mobilization Hangar 1 st Wave Construction begins	Summer: 2 nd Wave Construction site selection	October: All construction under Cantonment Division Second Kahn plan for Brooks Field, including Signal Corps Mobilization Hangar and U.S. All-Steel Hangar Fall: 3 rd Wave site selection, construction taken over by Cantonment Division	March: Cantonment Division becomes Construction Division, responsible for all Army planning and construction 4 th Wave site selection, mostly support facilities and especially Air Depots; construction taken over by Construction Division	5 th Wave construction activities conducted by Construction Division; again primarily support facilities	Summer: Decentralized construction at Long Island complex of 7 fields	

Table 2-2. First World War, U.S. Navy and Marine Corps aviation.

	APR – JUN 1917	JUL – SEP 1917	OCT – DEC 1917	JAN – MAR 1918	APR – JUN 1918	JUL – SEP 1918	OCT – NOV 1918
Military Conflicts	6 April: U.S. declares war on Germany						11 November: Armistice declared
Navy / Marine Corps Aircraft	N-9 Trainers; most common R-6 Patrol seaplanes, most common until HS-1			March: Introduction of HS-1 flying boat, most common in inventory		July: F-5L introduced as higher-performance flying boat	
Navy / Marine Corps Aviation Operations	April: Allies request U.S. aid against U-boat threat Anti-submarine warfare (ASW) is primary naval aviation wartime mission; immediate ASW patrols out of emergency facilities June: First U.S. unit to reach France is naval aviation squadron	Patrolling from coastal stations built by Bureau of Yards & Docks Operations out of 15 French coastal bases approved		January: 1 st Marine Aeronautic Company deploys to the Azores to conduct ASW patrols		August: 1 st Marine Aviation force arrives too late for bombing campaign versus U-boat pens; joins Navy's Northern Bombardment Group to support British offensive for rest of war	
Navy / Marine Corps Aviation Administration	Irwin named first Director of Naval Aviation Navy bureaus set up aviation sections; Yards & Docks coordinates construction campaign						
Construction Support for Navy / Marine Corps Aviation	April: Contracts for LTA hangars let immediately June: Site selection for first 8 patrol stations completed	NAS Pensacola receives 8 new wooden hangars; steel airship hangar also begun	Fall: Long Island patrol stations opening, others under construction Sept: 1 st wartime Navy wood-frame hangar completed at Bay Shore Preliminary flight training facilities added to existing stations	January: Final 2 of first 8 stations under construction Supplemental patrol stations under construction throughout rest of war April: First MCAS established at Miami	More training installations set up inland to ease burdens on coastal facilities	Contracts let for first permanent hangar construction at NAS San Diego NAS Pensacola receives 4 new steel hangars	

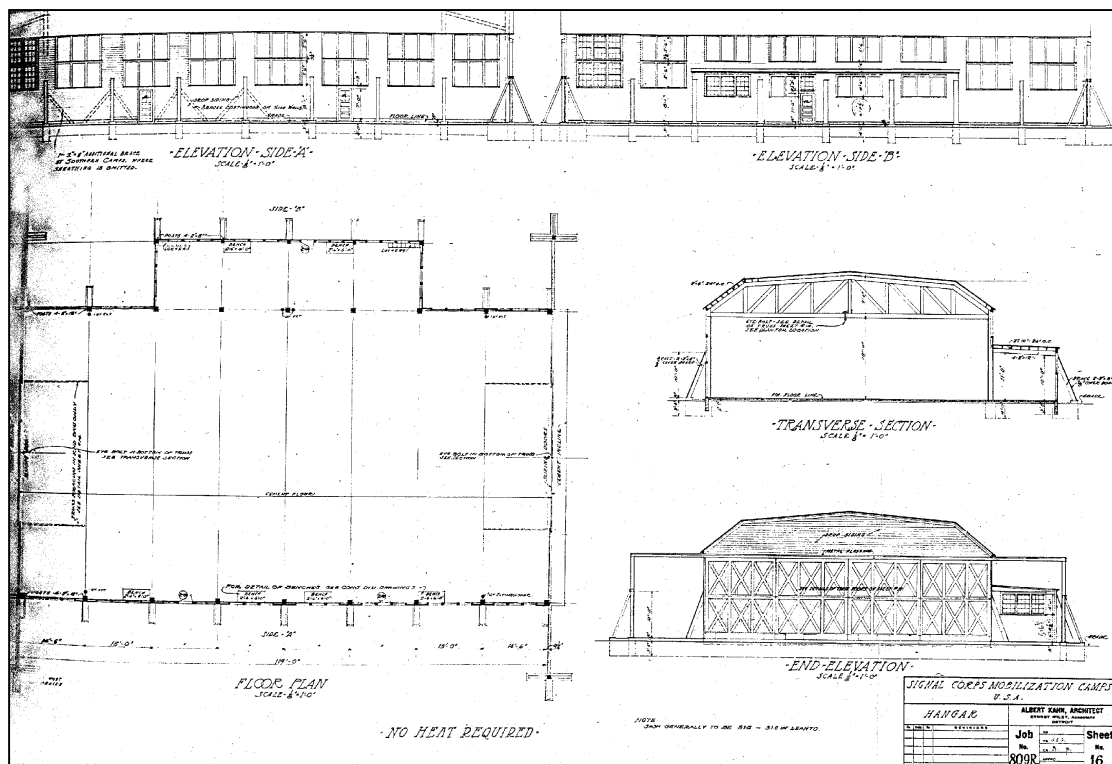


Figure 2-1. Albert Kahn's Signal Corps Mobilization Hangar, ca. 1917.



Figure 2-2. Kelly Field, TX, as an example of Albert Kahn's rectilinear standard layout for a single squadron Signal Corps Flying Field.



Figure 2-3. Irregular layout of Wright Field, OH, demonstrating a departure from Albert Kahn's prevalent rectilinear standard layout.

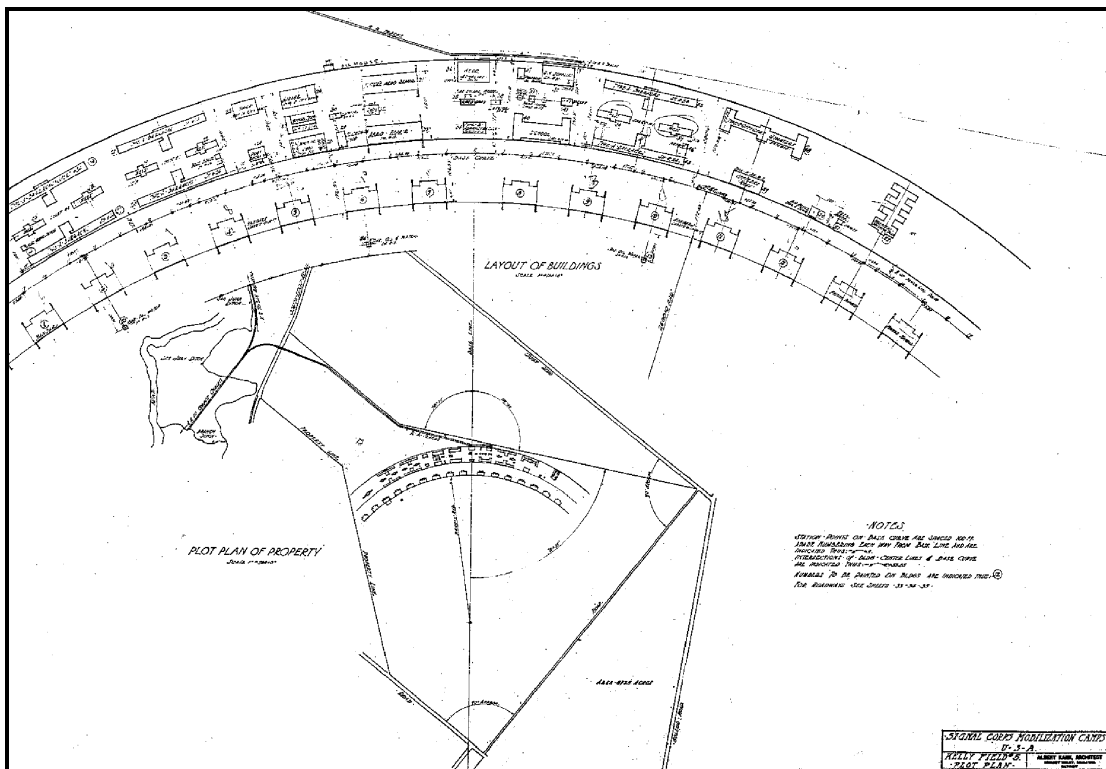


Figure 2-4. Albert Kahn's curvilinear design for Brooks Field, TX, ca. late 1917.



Figure 2-5. Only surviving example of Albert Kahn's Signal Corps Mobilization Hangar at Brooks Air Force Base, TX.

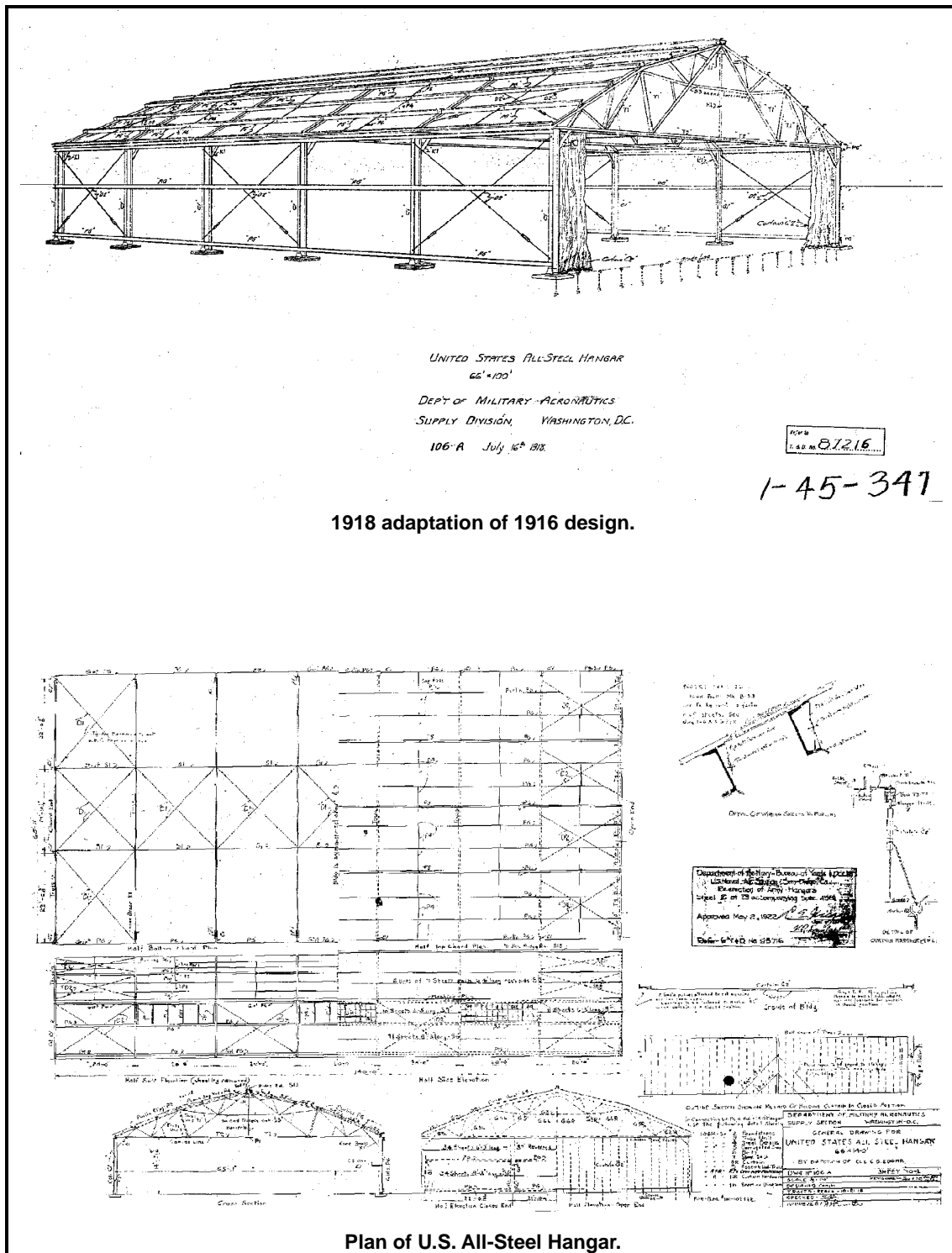




Figure 2-7. Oldest identifiable example of the U.S. All-Steel Hangar at Fort Sam Houston, TX, ca. 1917.



Figure 2-8. Scores of U.S. All-Steel Hangars at Langley Field, VA.

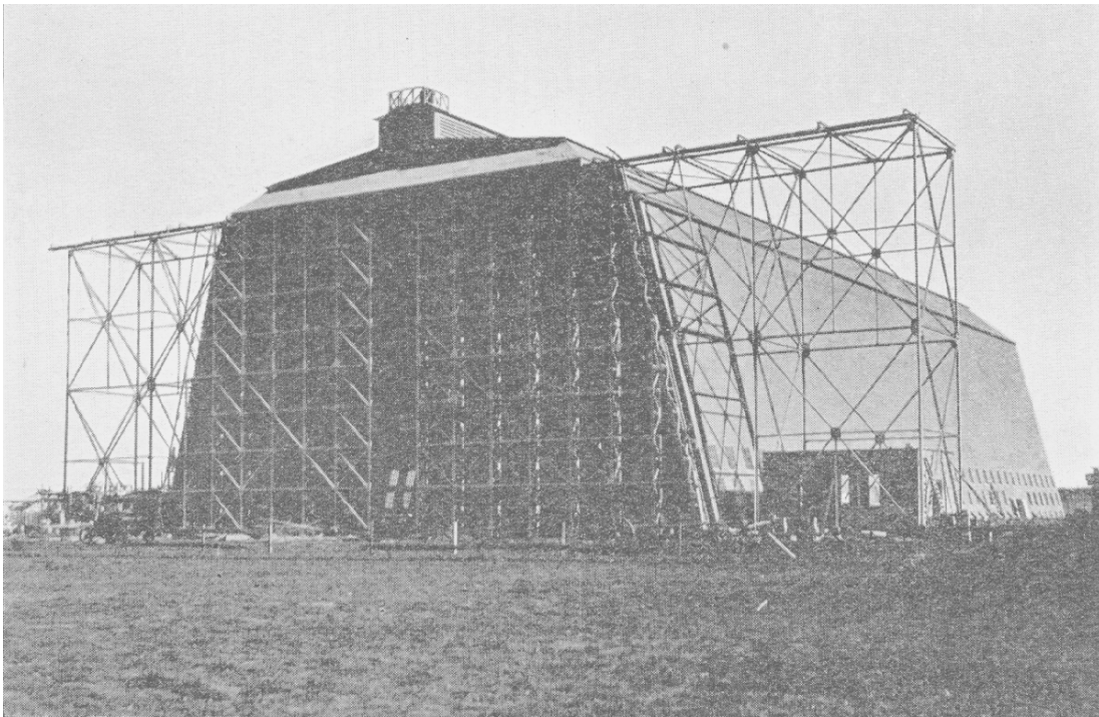


Figure 2-9. Standard continental naval air patrol station airship hangar at NAS San Diego, CA.

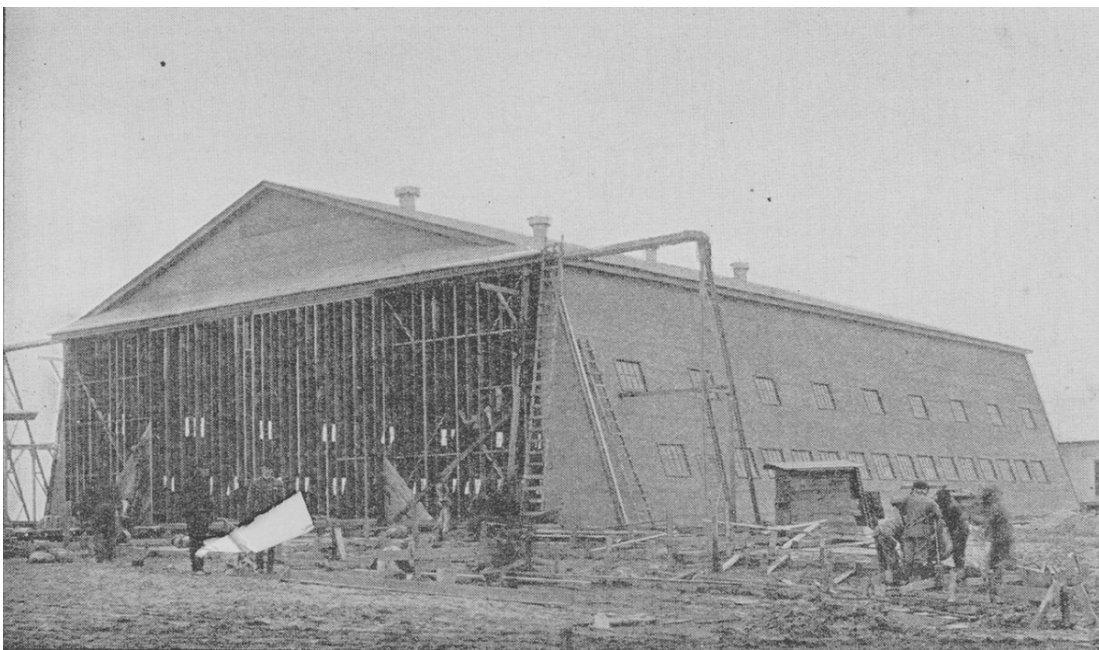


Figure 2-10. 75-Foot Coastal Air Station Seaplane Hangar at Cape May, NJ.

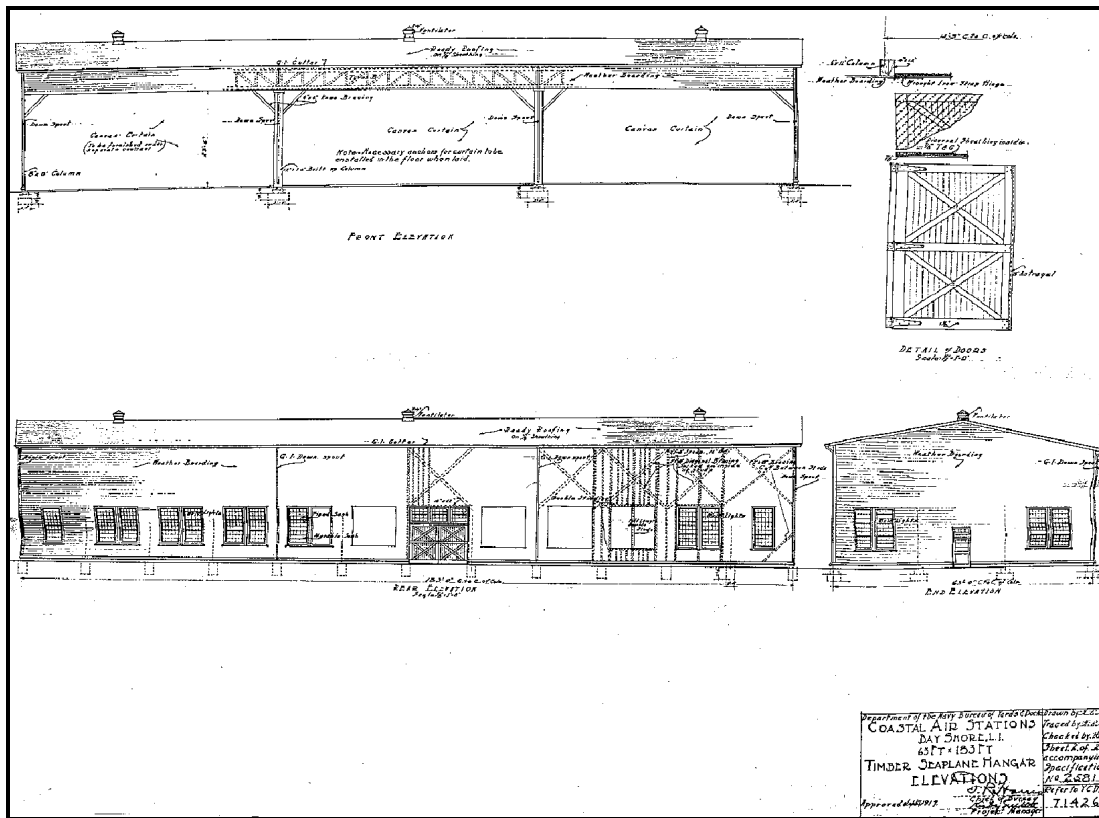


Figure 2-11. First wood-framed hangar erected by the Navy at Bay Shore, Long Island, NY.

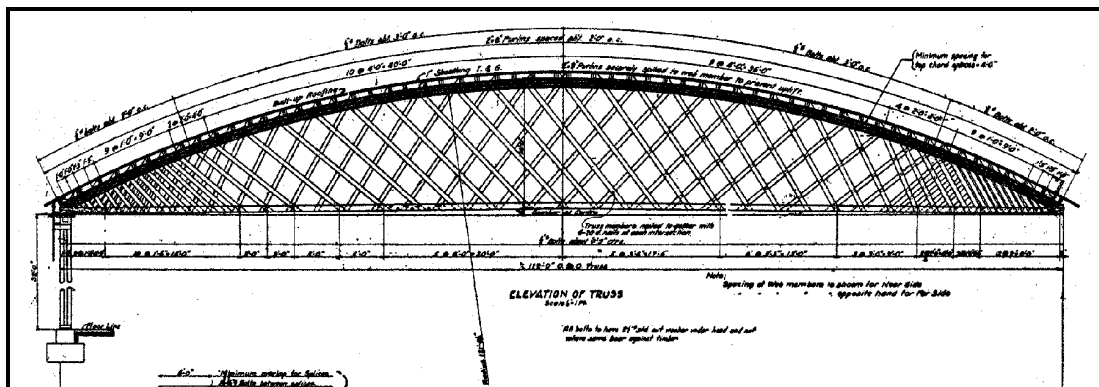


Figure 2-12. Elevation of the arched wood-lattice truss.

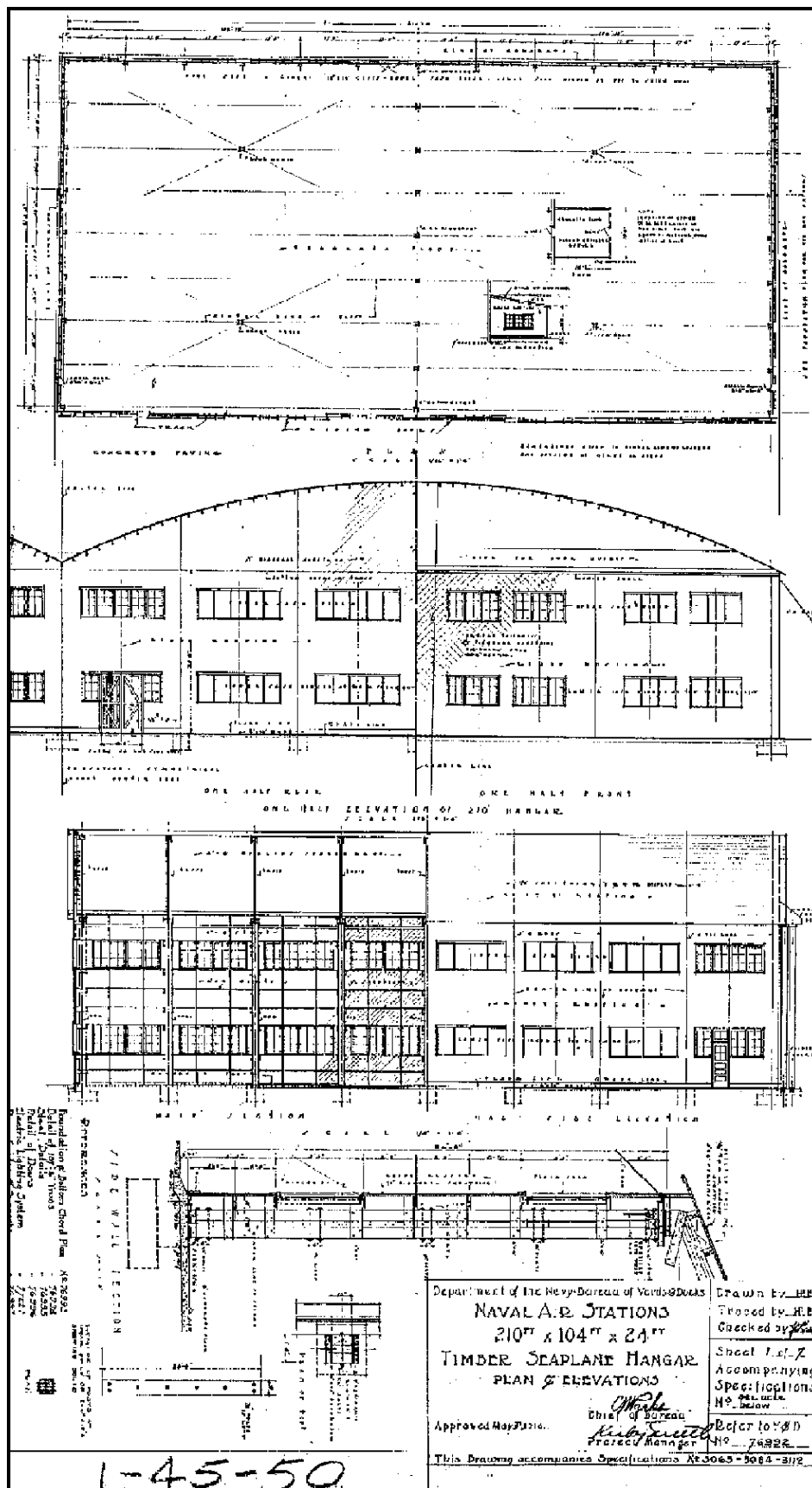


Figure 2-13. Plan for the 210 x 104 x 24 Foot Timber Seaplane Hangar.

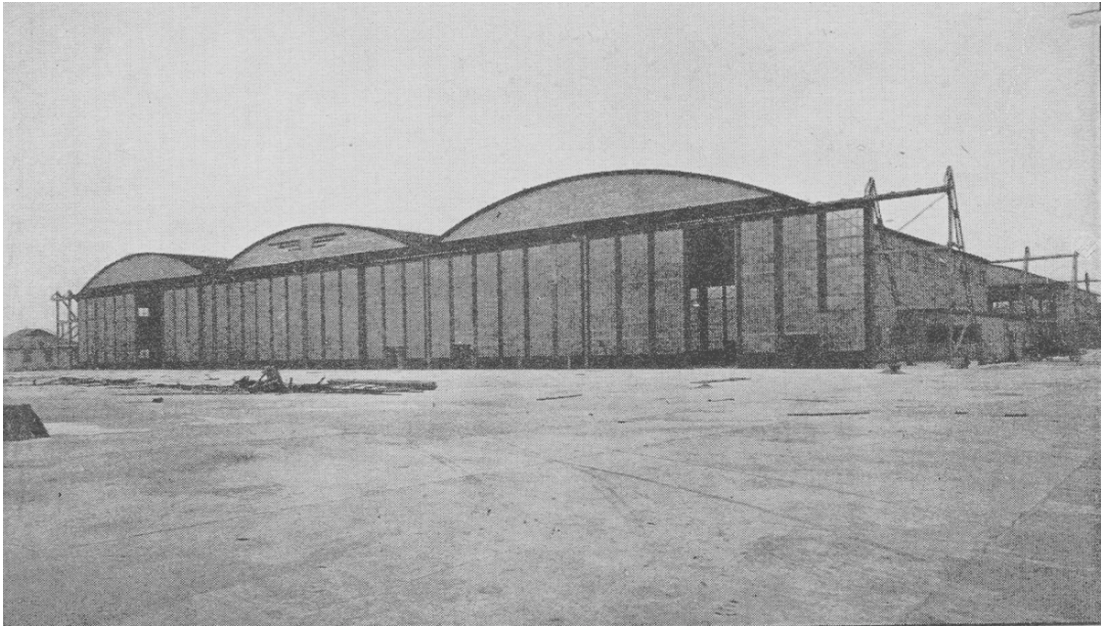


Figure 2-14. 220 x 160 x 32 Foot Timber Seaplane Hangars at Hampton Roads, VA.

Endnotes for Chapter 2

- 1 W. J. Boyne, *Silver Wings: A History of the United States Air Force* (Simon & Schuster, 1993), pp 37-47; *The Army Air Forces in World War II, Vol. I*, eds. W. F. Craven and J. L. Cate, (Washington, DC: Office of Air Force History, 1983), pp 5-10; H. M. Mason, *The United States Air Force: A Turbulent History* (Mason/Charter, 1976), pp 35-47.
- 2 Boyne, pp 50-55; Craven & Cate, pp 10-11.
- 3 Boyne, pp 55-76; Craven & Cate, pp 11-16; Mason, pp 49-71.
- 4 D. A. Anderton, *History of the U. S. Air Force* (Hamlyn Publishing Group, 1981), p 22; Boyne, pp 50-51.
- 5 Anderton, p 30; Glines, pp 81-82.
- 6 J. Brown, *Where Eagles Land: Planning and Development of U. S. Army Airfields, 1910-1941* (Greenwood Press, 1990), pp 35-37.
- 7 Lenore Fine and Jesse A. Remington, *The Corps of Engineers: Construction in the United States* (Office of the Chief of Military History, U.S. Army, 1972), pp 7-18; E. Risch, *Quartermaster Support of the Army: A History of the Corps, 1775-1939* (Office of the Quartermaster General, Quartermaster Historian's Office, 1962), pp 605-608; Brown, p 38.
- 8 Brigadier General R. C. Marshall, *History of the Construction Division of the Army*, (type-script) COE History Office, Fort Belvoir, VA, Military Files Holdings III, Box 1A, Part II, pp 212-215 and Book II, Exhibit 4, pp 82, 93-96 — hereafter referred to as "Marshall"; Fine & Remington, p 18; Risch, p 608.
- 9 Brown, p 38; Risch, p 609; Marshall, Book II, Exhibit 4, p 116.
- 10 Robert Mueller, *Air Force Bases*, Vol. I (Washington, DC: Office of Air Force History, USAF, 1989), pp 78, 268, 364, 376, 510; Brown, p 39; Historical Building Information supplied by Brooks AFB; Standard Plan for Signal Corps Mobilization Hangar, from: .
- 11 Manual for the Quartermaster Corps, U.S. Army, 1916, Vol. I, pp 453, 460.
- 12 *Brooks Air Force Base: The First Seventy-Five Years* 1992, p 5.
- 13 M.D. Freeman, *Fort Sam Houston: An American Depot, Headquarters, and Training Facility, 1876-1946* (U.S. Army Corps of Engineers, Fort Worth District, 1994), p 89; *Brooks Air Force Base: The First Seventy-Five Years* (supplied by Brooks AFB, 1992), p 5; Construction Completion Report of 29 December 1939, Office of the Quartermaster, Fort Sam Houston, TX (supplied by Fort Sam Houston Museum); Bureau of Yards and Docks Drawings on Film Collection, NA RG 71, Rolls 1066-1067, NAS North Island; Construction Completion Report of 11 January 1919, Bolling Field, DC, NA RG 92, Vol. 69; Robert I. Curtiss, et al., *Langley Field: The Early Years, 1916-1946*, (Langley AFB, VA: Office of History, 4500th Air Base Wing, 1977), pp 28, 35, 55.
- 14 Brown, pp 41, 48; Marshall, Book I, Exhibit 3, pp 96-97, 116; *Hearings, Real Estate Purchases*, before the Subcommittee of the Committee on Military Affairs, Senate, 66th Congress, 1st Session, 1919, pp 25-27, 88-89.
- 15 Brown, p 44.
- 16 Curtiss et al., pp 25-28, 33-35.
- 17 Brown, pp 39, 41-42.
- 18 Brown 1990, pp 40-41, Map 2 on pp 50-51; Mueller 1989, p xvii, and throughout.
- 19 Brown 1990, pp 42-43, Map 2; Mueller 1989.

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- 20 Brown 1990, p 45, Map 2; Mueller 1989.
 - 21 Brown 1990, p 47, Map 2; Marshall, Part I, pp 59-60.
 - 22 Captain Archibald D. Turnbull, USNR, and Lieutenant Commander Clifford L. Lord, USNR, *History of United States Naval Aviation* (Yale University Press, 1949), pp 96-97; NAVAIR 00-80P-1, *United States Naval Aviation, 1910-1970* (Deputy Chief of Naval Operations (Air), 1970), p 24.
 - 23 Turnbull and Lord, pp 98-115.
 - 24 Paolo Coletta, ed., *United States Navy and Marine Corps Bases, Domestic* (Westport, CN: Greenwood Press, 1985), p 149.
 - 25 NAVAIR 00-80P-1, pp 4-35; Turnbull and Lord, pp 113-140.
 - 26 NAVAIR 00-80P-1, p 35; Turnbull and Lord, pp 139-141, 147.
 - 27 *Activities of the Bureau of Yards and Docks, Navy Department: World War, 1917-1918* (Government Printing Office, 1921), p 396.
 - 28 *Ibid.*
 - 29 Coletta, p 150.
 - 30 *Ibid.*, pp 7-10.
 - 31 NAVAIR 00-80P-1, p 29; BuDocks, p 403.
 - 32 Coletta, p 305; Turnbull & Lord, p 102.
 - 33 Coletta, p 150.
 - 34 BuDocks, p 407.
 - 35 *The Cradle*, p 55.
 - 36 Coletta, p 149.
 - 37 Turnbull and Lord, p 126.
 - 38 BuDocks, p 411; *The Cradle*, p 59.
 - 39 Fahey, et al., *The Architectural/Historical Significance of Buildings at Naval Air Station, North Island* (San Diego: U.S. Naval Air Station, North Island, 1988), pp, 15, 18-26; BuDocks, pp 408, 412.
 - 40 Lieutenant Colonel Edward C. Johnson, USMC, *Marine Corps Aviation: The Early Years, 1912-1940* (History and Museums Division: Headquarters, U.S. Marine Corps, 1977), pp 10-11, 27.
 - 41 *Ibid.*, pp 11-12.
 - 42 Major General John P. Condon, USMC (Ret.), *U.S. Marine Corps Aviation* (Deputy Chief of Naval Operations (Air Warfare), 1987), p 4; Johnson, pp 12-14.
 - 43 Johnson, pp 15-16.
 - 44 *Ibid.*, pp 17-26.
 - 45 Johnson, p 18; Condon, pp 5-6; Coletta, p 421; NAVAIR 00-80P-1, p 32.